

FAIRifying a database: Experience with the COMETS database



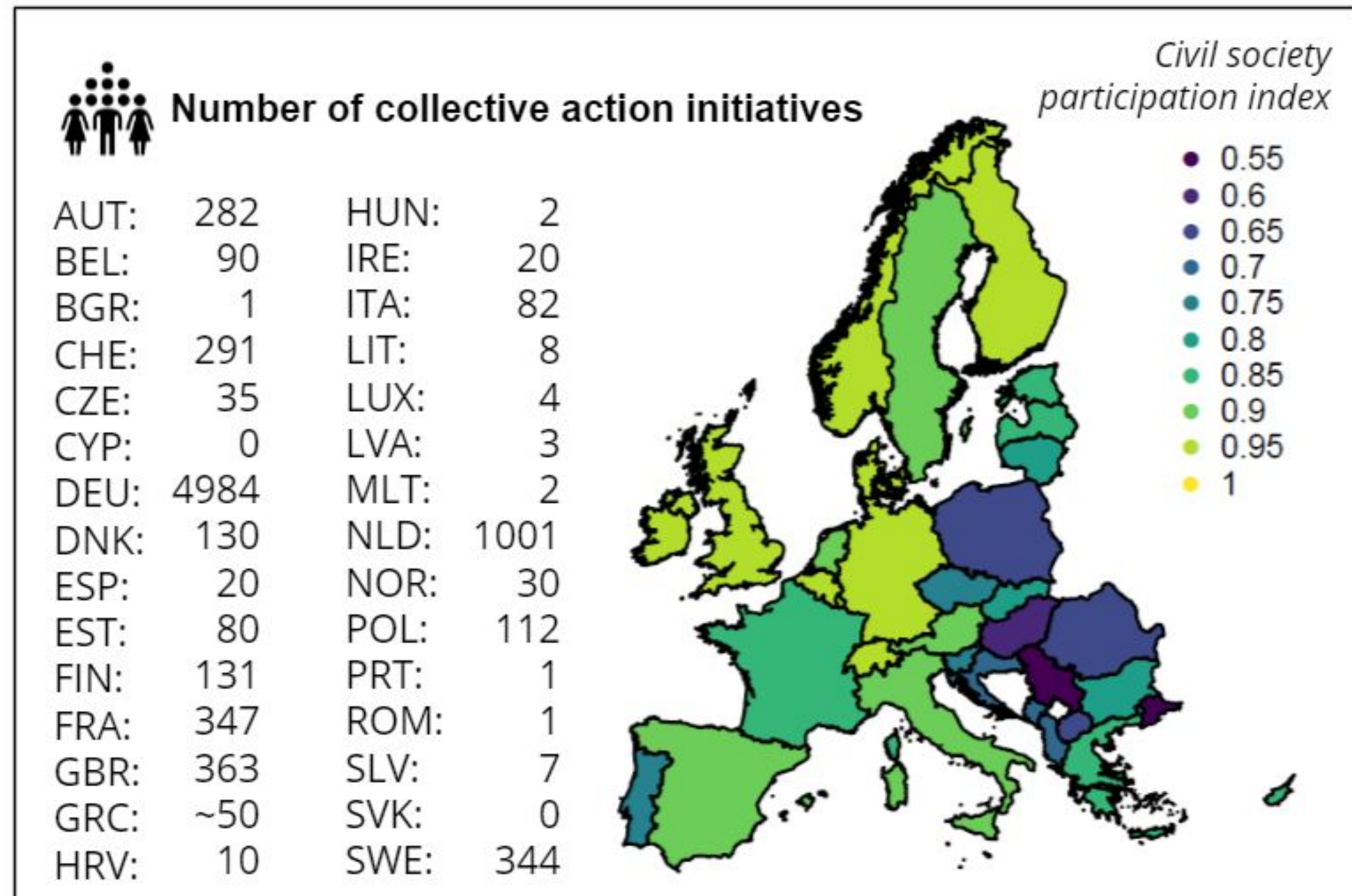
- 1 The COMETS inventory
- 2 Implementation strategy
- 3 Metadata selection and criteria
- 4 Preparing the data, RDF tools
- 5 Accessing the database with SPARQL
- 6 A few showcases
- 7 Conclusions

1.The COMETS inventory: What data are collected ?

Report from the Commission to the European Parliament and the Council “Progress on competitiveness of clean energy technologies”:

... Currently, at least two million European citizens collectively engage in more than 8400 energy communities, having realized a minimum of 13000 projects since 2000 (Schwanitz et al. 2021).

....Current total renewable capacities installed by energy communities in Europe can be estimated at least as high as 6.3 GW, contributing up to 7% to the nationally installed capacities. The lion's share is taken by solar PV (~50%), followed by onshore wind (~10%). A conservative estimate of the total invested finances amounts to at least 2.6 billion EUR (ibid). The continuation and extension of energy communities in Europe depends on favorable legislation and financial incentives as well as on the competitiveness of technologies that are accessible to citizens. ...



Source: Schwanitz et al., DOI:10.31235/osf.io/2ymuh

1.The COMETS inventory: What data are collected ?

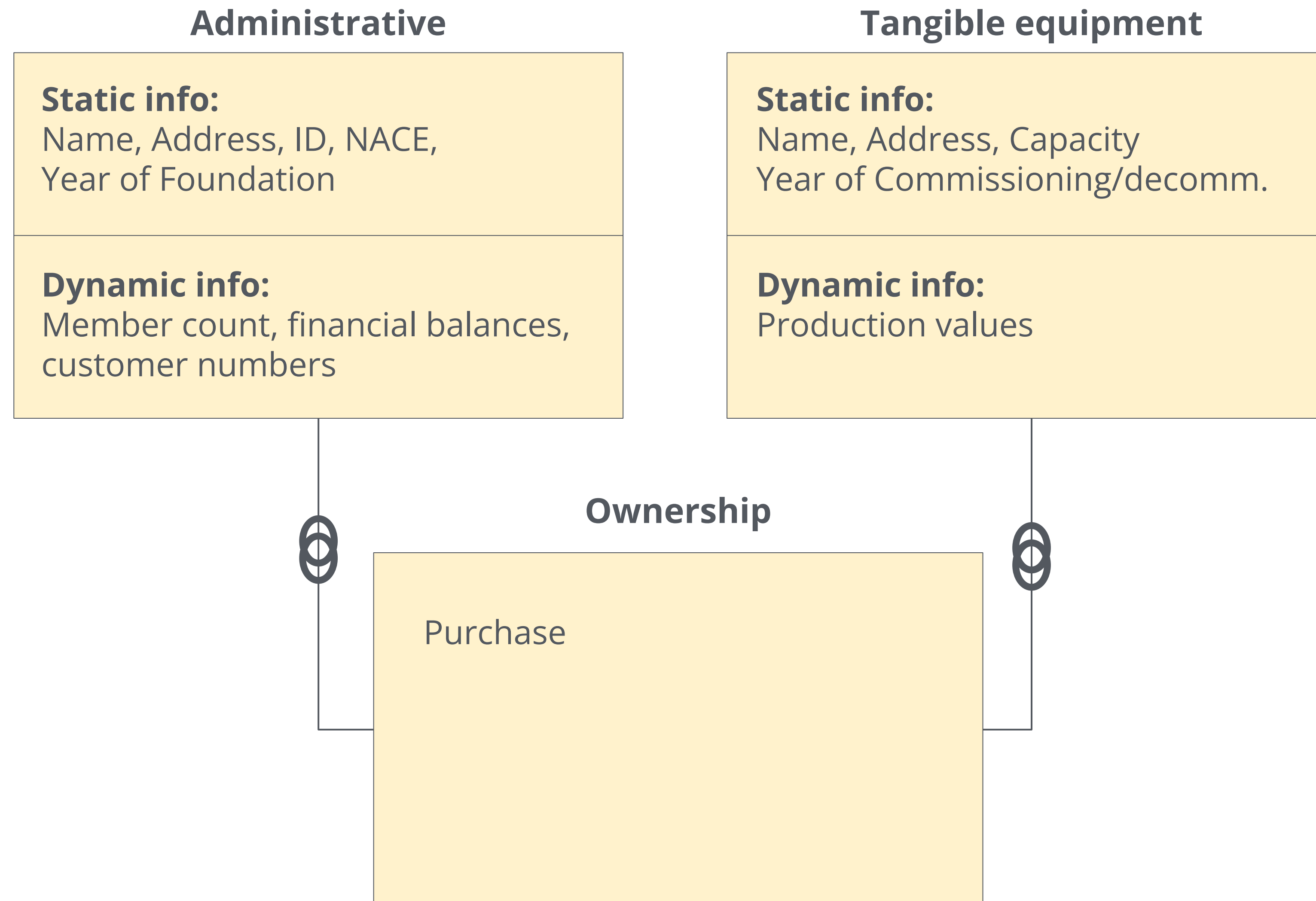
List of properties:

- company_ID
- Plant_ID
- Unit_ID
- company name
- cvr number
- plant name
- address
- zipcode
- town
- municipality_ID
- type of plant
- district heating net_ID
- district heating network name
- unit name
- unit type
- commissioning
- decommissioning
- electric capacity_MW
- heating capacity_MW
- main fuel
- main fuel type
- share - coal
- share - oil
- share - natural gas
- share - waste
- share - biogas
- share - solid biomass
- share - bio oil
- share - no fuels
- share - solar
- share - hydro
- share - electricity
- UTM X
- UTM Y



CC4.0

1.The COMETS inventory: General data layout

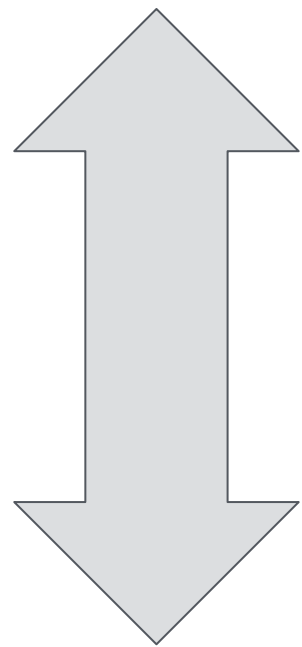


2. Implementation constraints and strategy

- no binary format, but readable text
- combine several linked datasets into one document
- offer basic search functionality without an extensive GUI
- offer extensibility without major layout changes
- can be distributed as a single file
- implement FAIR principles
- granularity of data different between countries

2. Why using RDF (Resource Description Framework)?

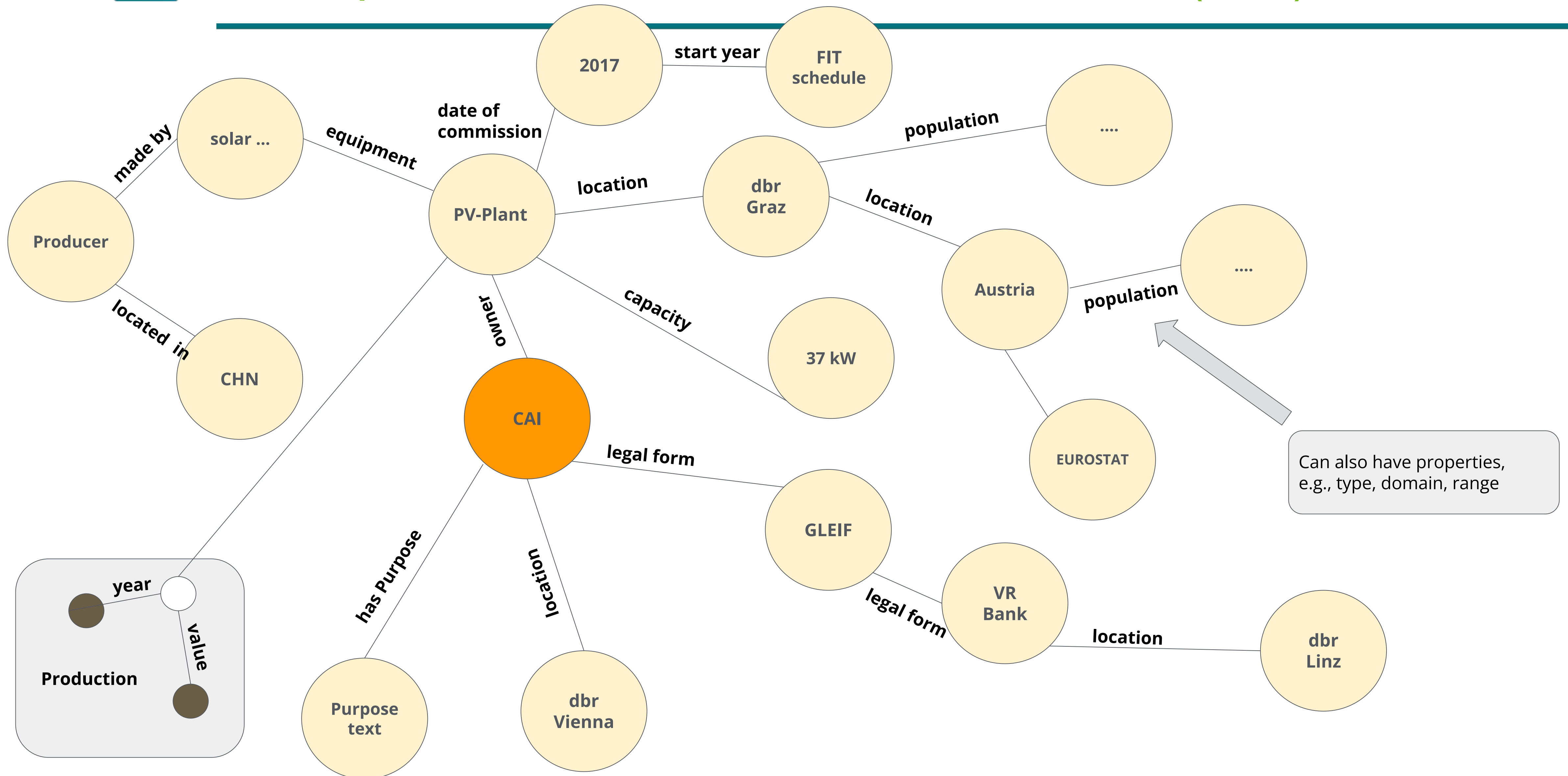
Advantages



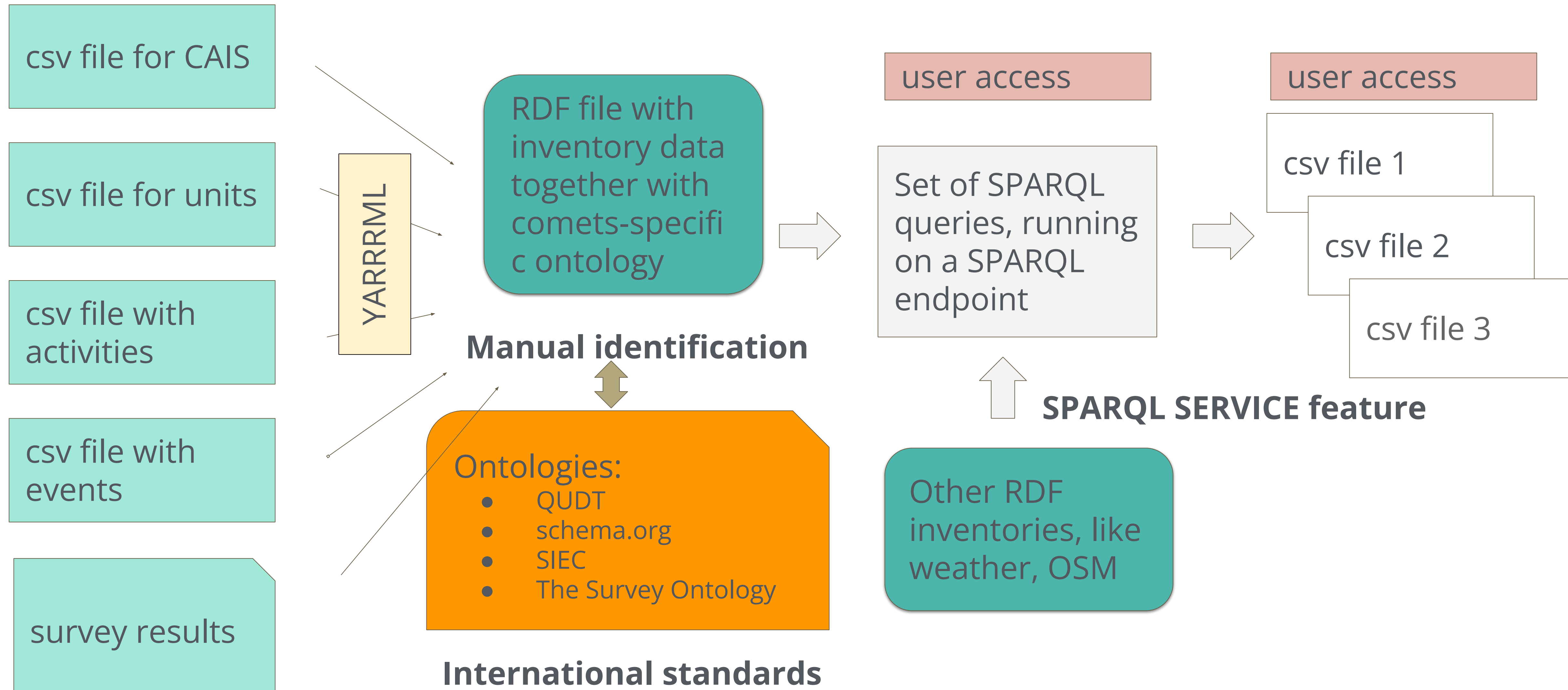
Disadvantages

- Use of IRIs allows to globally identify properties and object
 - RDF statements (graphs) can be merged to joint different sources
 - RDF is lingua franca of the semantic web and linked data
 - RDF is extensible and flexible (e.g., easy to change single entries)
 - Offers a rich documentation (e.g., has Dublin core implementation)
 - Offers possibilities for inference
 - Allows high modularity of concepts
 - Turtle is a user-friendly serialization of RDF
 - SPARQL can be used to query RDF data stores
-
- RDF has only limited validation support (SHACL etc. upcoming)

Example: Information about one initiative (CAI)



2. COMETS inventory: General workflow



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Step A: Define the prime data objects in your problem

Step B: Establish a concept of metadata to be used

Step C: Connect your dataset to the metadata within a given technology. *Here: RDF*

Step D: Make the dataset available. *Here fuseki and SPARQL*

Step E: Leave room for improvement

2. COMETS inventory: General workflow

Step A: Define the prime data objects in your problem

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Step D: Make the dataset available. Here [fuseki and SPARQL](#)

Step E: Leave room for improvement

2. Short introduction to RDF and RDF tools

Statements of **subject**, **predicate**, and **object**

| | | |
|------------------|-------------------|--------------------------------------------|
| comets:cai_esp_1 | rdf:type | schema:Organization . |
| comets:cai_esp_1 | rdf:type | comets:CAI . |
| comets:cai_esp_1 | rdf:type | rov:RegisteredOrganization . |
| comets:cai_esp_1 | schema:name | "ELÉCTRICA DE GUADASSUAR S. COOP. V."@es . |
| comets:cai_esp_1 | schema:identifier | "F46004750" . |
| comets:cai_esp_1 | wikidata:P298 | "ESP" . |

Each entry corresponds to a http page

2. RDF validation tools

IDLab Turtle Validator

This is the web version of the NodeJS [Turtle Validator](#), which is also available as a command line tool.

Paste your turtle file in here and press validate

```
1 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix comets: <http://www.comets-project.eu/> .
4 @prefix rov: <http://www.w3.org/ns/regorg#> .
5 @prefix wikidata: <https://www.wikidata.org/wiki/> .
6
7
8 comets:cai_esp_1 rdf:type schema:Organization .
9 comets:cai_esp_1 rdf:type comets:CAI .
10 comets:cai_esp_1 rdf:type rov:RegisteredOrganization .
11 comets:cai_esp_1 schema:name "ELÉCTRICA DE GUADASSUAR S. COOP. V."@es .
12 comets:cai_esp_1 schema:identifier "F46004750" .
13 comets:cai_esp_1 wikidata:P298 "ESP" .
14
15
16
17
18
19
20
```

Validate!

Congrats! Your syntax is correct.

Link to try: <http://ttl.summerofcode.be/>

2. RDF validation tools

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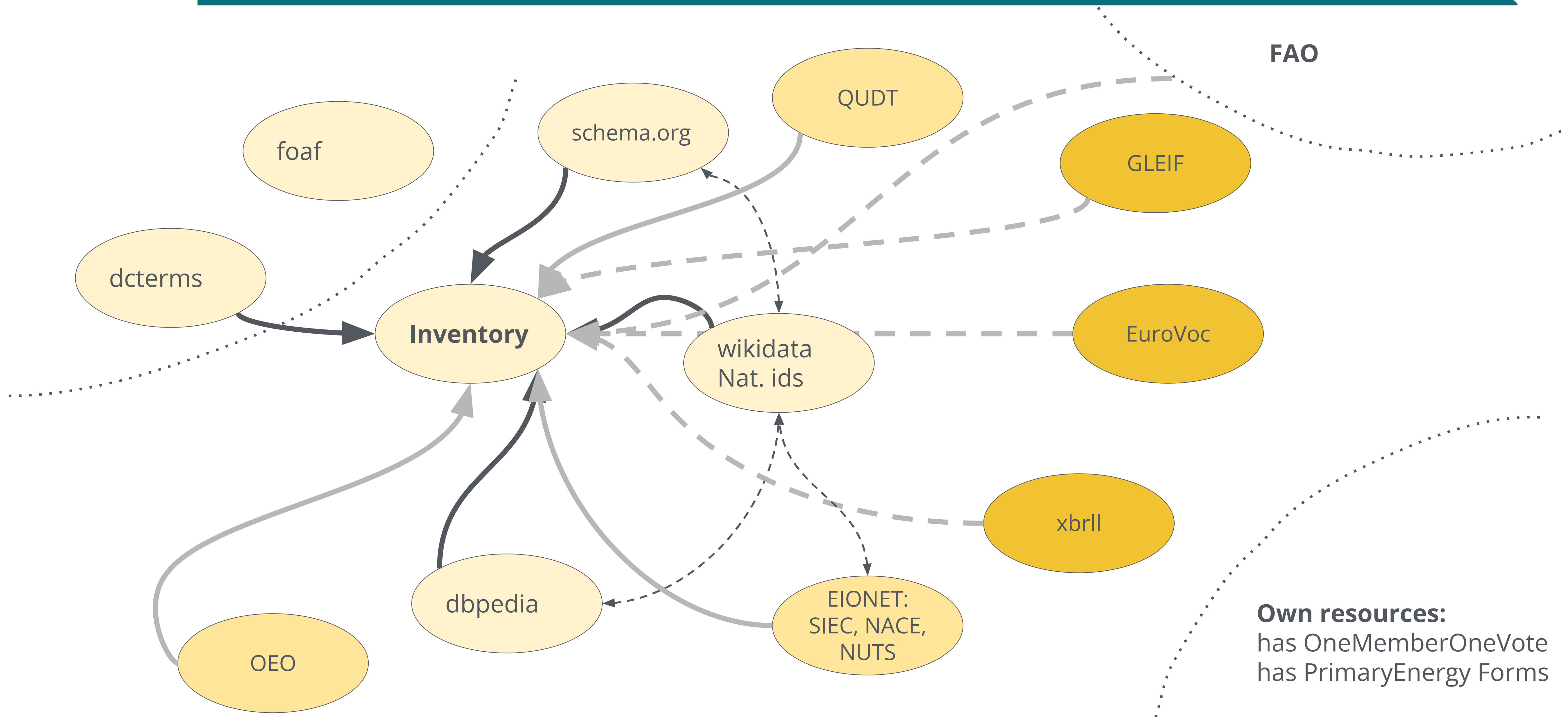
Paste your turtle file in here and press validate

```
1 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix comets: <http://www.comets-project.eu/> .
4 @prefix rov: <http://www.w3.org/ns/regorg#> .
5 @prefix wikidata: <https://www.wikidata.org/wiki/> .
6
7
8 comets:cai_esp_1 rdf:type schema:Organization .
9 comets:cai_esp_1 rdf:type comets:CAI .
10 comets:cai_esp_1 rdf:type rov:RegisteredOrganization .
11 comets:cai_esp_1 schema:name "ELÉCTRICA DE GUADASSUAR S. COOP. V."@es ;
12 comets:cai_esp_1 schema:identifier "F46004750" .
13 comets:cai_esp_1 wikidata:P298 "ESP" .
14
15
16
17
18
19
20
```


Validate!

- Expected punctuation to follow "http://schema.org/identifier" on line 12.

3. Metadata example: concepts in wikidata



3. Metadata example: concepts in wikidata



[Main page](#)
[Community portal](#)
[Project chat](#)
[Create a new Item](#)
[Recent changes](#)
[Random Item](#)
[Query Service](#)
[Nearby](#)
[Help](#)
[Donate](#)

[Lexicographical data](#)
[Create a new Lexeme](#)
[Recent changes](#)
[Random Lexeme](#)

[Tools](#)

Property
Discussion
Read
View history

legal form (P1454)

legal form of an entity
type of business entity | legal structure | structured as

▼ In more languages
Configure

| Language | Label | Description | Also known as |
|----------|------------------|-----------------------------------------------------|-------------------------------------------------------------|
| English | legal form | legal form of an entity | type of business entity legal structure structured as |
| German | Rechtsform | Rechtsform einer Organisation an ihrem Sitz | |
| norsk | No label defined | No description defined | |
| Italian | forma giuridica | forma giuridica di un'organizzazione o associazione | tipo di impresa |

All entered languages

Try it out: <https://www.wikidata.org/wiki/Property:P1454>

3. Metadata example: concepts taken from schema.org

<https://schema.org/streetAddress>

<https://schema.org/addressLocality>

<https://schema.org/postalCode>

<https://schema.org/foundingDate>

<https://schema.org/dissolutionDate>

<https://schema.org/makesOffer>

Schema.org

Organization

A Schema.org Type


Thing > Organization

An organization such as a school, NGO, corporation, club, etc

| Property | Expected Type |
|------------------------------|-------------------------------------------------|
| Properties from Organization | |
| actionableFeedbackPolicy | CreativeWork or URL |
| address | PostalAddress or Text |
| aggregateRating | AggregateRating |
| alumni | Person |
| areaServed | AdministrativeArea or GeoShape or Place or Text |
| award | Text |
| brand | Brand or |

3. Metadata example: Open Energy Ontology

Link: http://openenergy-platform.org/ontology/oeo/OEO_00000031

Database Factsheets ▾ Ontology ▾ Tutorials About ▾

Class label: power plant

Definition:
A power plant is an energy transformation unit consisting of power generating units and a grid component that feeds electric energy into an electric grid.

Sub classes:

| | |
|----------------------|----------------------|
| waste power plant | view |
| hydrogen power plant | view |
| nuclear power plant | view |
| wind farm | view |

3. Metadata example: QUDT

@prefix qudt-1-1: <<http://qudt.org/1.1/schema/qudt#>> .

@prefix qudt-unit-1-1: <<http://qudt.org/1.1/vocab/unit#>> .

```
cap1    a                qudt-1-1:QuantityValue ;
        qudt-1-1:unit      qudt-unit-1-1:KiloW-HR ;
        qudt-1-1:numericValue "29"^^xsd:double .
```

unit:KiloW-HR

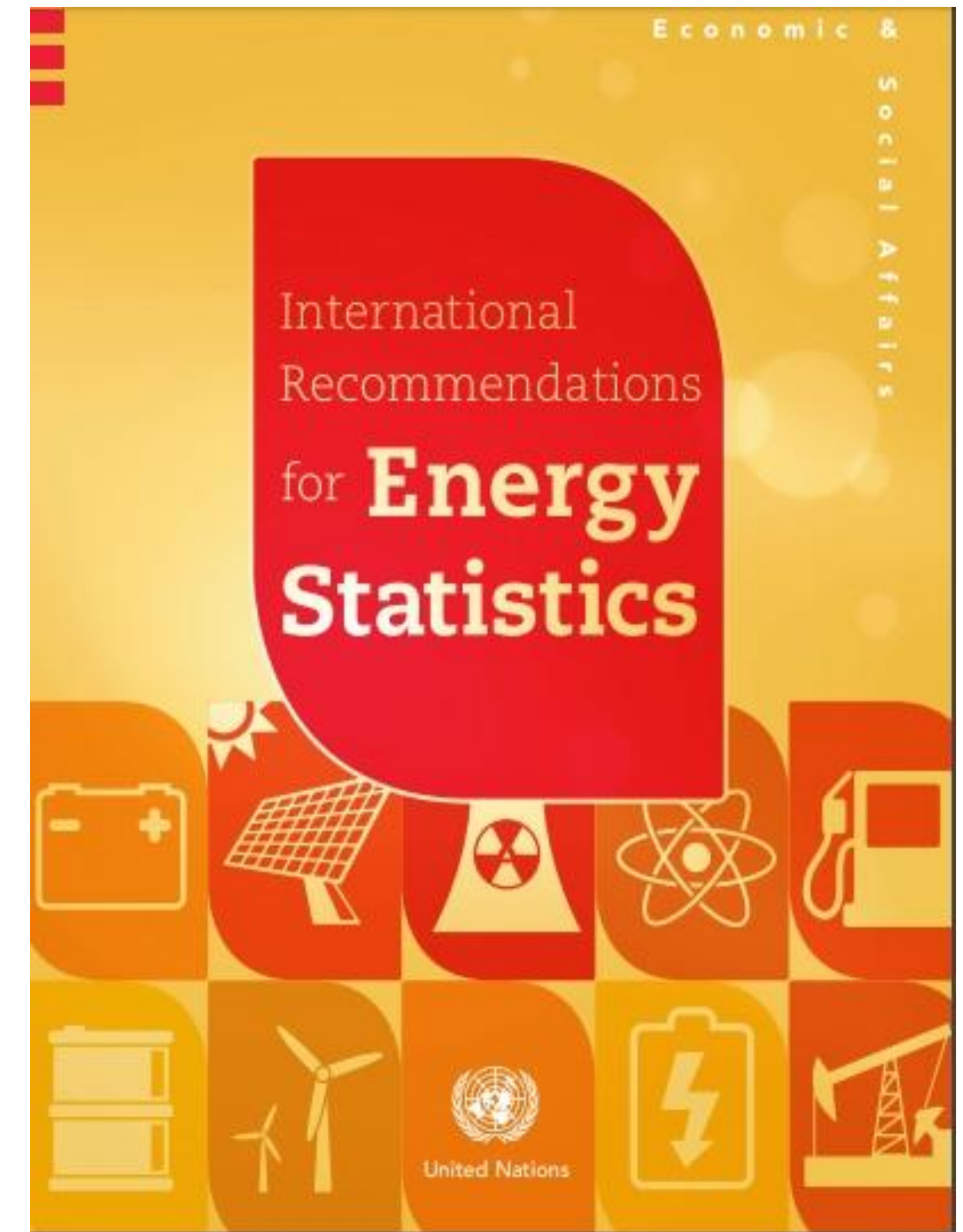
URI: <http://qudt.org/vocab/unit/KiloW-HR>

see the definition: <http://qudt.org/vocab/unit/KiloW-HR>

3. Metadata example: Standard International Energy Product Classification

| | |
|---------------------|-------------------------------------------------------------------------------------------------------------------------|
| Folder | eurostat (Eurostat dictionaries) |
| Identifier | siec |
| Label | Standard international energy product classification (SIEC) |
| Base URI | http://dd.eionet.europa.eu/vocabulary/eurostat/siec/ |
| Registration status | Released 22 Oct 2020 14:03:50 |

| Id | Label | Status | Status Modified | Notation |
|----------------|--------------------------------------|--------|-----------------|----------------|
| RA130 | Pumped hydro power | Valid | 07.12.2018 | RA130 |
| RA200 | Geothermal | Valid | 07.12.2018 | RA200 |
| RA300 | Wind | Valid | 07.12.2018 | RA300 |
| RA310 | Wind on shore | Valid | 07.12.2018 | RA310 |
| RA320 | Wind off shore | Valid | 07.12.2018 | RA320 |
| RA400 | Solar | Valid | 07.12.2018 | RA400 |
| RA410 | Solar thermal | Valid | 07.12.2018 | RA410 |
| RA420 | Solar photovoltaic | Valid | 07.12.2018 | RA420 |
| RA420KW20-1000 | Solar photovoltaic (20 kW - 1000 kW) | Valid | 07.12.2018 | RA420KW20-1000 |



3. Comparison of available concepts

| Type | Comets | SIEC | wikidata | oeo |
|-----------------------|-----------------|-------|-----------|--------------|
| Power station | PowerPlant | | Q159719 | OEO_00000031 |
| Solar PV | PVPlant | RA420 | Q1003207 | OEO_00000324 |
| Hydropower | HydropowerPlant | RA100 | Q15911738 | OEO_00010086 |
| Wind turbine | WindTurbine | RA310 | Q49833 | OEO_00000044 |
| Wind farm, onshore | WindFarm | RA310 | Q194356 | OEO_00000311 |
| Biogas power plant | | | | OEO_00000004 |

4. Turning data into RDF triples: YARRRML



Or, check our screencasts:

- [Matey, with Targets \(ISWC 2021 demo\)](#)
- [Matey, the original \(ESWC 2018 demo\)](#)

Reload example:

 People (JSON)

 Advanced

Facebook

Targets

Actions:

Generate RML

Generate LD

Input: Data ▾



| ID | NUTS3 | CODE |
|----|-------|-------|
| 36 | FR105 | 92700 |
| 37 | FR105 | 92800 |
| 38 | FR105 | 93450 |
| 39 | FRB04 | 37000 |
| 40 | FRB04 | 37100 |
| 41 | FRB04 | 37110 |
| 42 | FRB04 | 37120 |
| 43 | FRB04 | 37130 |
| 44 | FRB04 | 37140 |
| 45 | FRB04 | 37150 |

Input: YARRRML ▾

```

1 - prefixes:
2   schema: http://schema.org/
3   comets: http://www.comets-project.eu/
4   nuts:   http://dd.eionet.europa.eu/vocabulary/common/
5   wikidata: https://www.wikidata.org/entity/
6
7 - mappings:
8   units:
9     sources:
10    access: postal_NUTS.csv
11    referenceFormulation: csv
12    s: comets:postal_nuts_$(ID)
13    po:
14      - [a, comets:auxiliary_info]
```

Output: Turtle/TriG ▾

```

1 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
2 @prefix ma: <http://www.comets-project.eu/ontology/auxiliary_info#> .
3 @prefix schema: <http://schema.org/PostalCodeType#> .
4 @prefix comets: <http://www.comets-project.eu/ontology/auxiliary_info#> .
5 @prefix nuts: <http://dd.eionet.europa.eu/vocabulary/common/nuts3#> .
6 @prefix wikidata: <https://www.wikidata.org/entity/P605#> .
7
8 comets:postal_nuts_36 a schema:PostalCodeType ;
9   wikidata:P605 ;
10   schema:postalCode "92700" ;
11
12 comets:postal_nuts_37 a schema:PostalCodeType ;
13   wikidata:P605 ;
14   schema:postalCode "92800" ;
```


4. Turning data into RDF triples: YARRRML

Try it: <https://rml.io/yarrrml/matey/>

| ID | NUTS3 | CODE |
|----|-------|-------|
| 36 | FR105 | 92700 |
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| 39 | FRB04 | 37000 |
| 40 | FRB04 | 37100 |
| 41 | FRB04 | 37110 |
| 42 | FRB04 | 37120 |
| 43 | FRB04 | 37130 |
| 44 | FRB04 | 37140 |
| 45 | FRB04 | 37150 |

prefixes:

schema: <http://schema.org/>

comets: <http://www.comets-project.eu/>

nuts: <http://dd.eionet.europa.eu/vocabulary/common/nuts2016/>

wikidata: <https://www.wikidata.org/entity/>

mappings:

units:

sources:

access: postal_NUTS.csv

referenceFormulation: csv

s: comets:postal_nuts_\$(ID)

po:

- [a, comets:auxiliary_info]

- [wikidata:P605, nuts:\$(NUTS3)]

- [schema:postalCode, \$(CODE)]

4. Turning data into RDF triples: YARRRML

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
@prefix ma: <http://www.w3.org/ns/ma-ont#> .  
@prefix schema: <http://schema.org/> .  
@prefix comets: <http://www.comets-project.eu/> .  
@prefix nuts: <http://dd.eionet.europa.eu/vocabulary/common/nuts2016/> .  
@prefix wikidata: <https://www.wikidata.org/entity/> .
```

```
comets:postal_nuts_36 rdf:type comets:auxiliary_info ;  
    wikidata:P605 nuts:FR105 ;  
    schema:postalCode "92700" .
```

```
comets:postal_nuts_37 rdf:type comets:auxiliary_info ;  
    wikidata:P605 nuts:FR105 ;  
    schema:postalCode "92800" .
```

```
comets:postal_nuts_38 rdf:type comets:auxiliary_info ;  
    wikidata:P605 nuts:FR105 ;  
    schema:postalCode "93450" .
```

4. SKOS implementation of a vocabulary

Production

DA 2022-01-10

DEF Production of primary, secondary or final energy.

BT Energy sector activity

NT Solar

NT Geothermal

NT Wind

NT Biofuels

Solar

DA 2022-01-10

DEF Electricity generation based on the conversion of light

BT Production

NT Photovoltaics

NT Concentrated solar

NT Thermal

```
comets:activity_type_1 rdf:type skos:Concept ;
  skos:inScheme comets:activities_vocabulary ;
  skos:prefLabel "Production"@en ;
  skos:definition "Production of primary, secondary or final energy. "@en ;
  skos:broader comets:activity_type_0 ;
  skos:narrower comets:activity_type_2 ;
  skos:narrower comets:activity_type_10 ;
  skos:narrower comets:activity_type_6 ;
  skos:narrower comets:activity_type_14 .
```

```
comets:activity_type_2 rdf:type skos:Concept ;
  skos:inScheme comets:activities_vocabulary ;
  skos:prefLabel "Solar "@en ;
  skos:definition "Electricity generation based on the conversion of light "@en ;
  skos:broader comets:activity_type_1 ;
  skos:narrower comets:activity_type_3 ;
  skos:narrower comets:activity_type_4 ;
  skos:narrower comets:activity_type_5 .
```


5. A short introduction to SPARQL

Search for RDF triples which obey certain conditions:

Find founding dates for all initiatives, and report name and date

```
SELECT ?cainame ?date
```

```
WHERE {
```

```
    ?cai rdf:type comets:CAI;
        schema:name ?cainame ;
        schema:foundingDate ?date .
```

```
}
```

| | cainame | ↕ | date |
|----|--------------------------------------------------------------------|---|-------------------|
| 1 | "Saint Martin du Durzon"@fr | | "2013"^^xsd:gYear |
| 2 | "Site à Watts Developpement"@fr | | "2011"^^xsd:gYear |
| 3 | "Colibris"@fr | | "2006"^^xsd:gYear |
| 4 | "Energ'Ethic 04"@fr | | "2012"^^xsd:gYear |
| 5 | "Coop'Demain"@fr | | "2019"^^xsd:gYear |
| 6 | "Centrales Villageoises Beaujolais Pierres Dorées - Cevidorées"@fr | | "2020"^^xsd:gYear |
| 7 | "Cap Soleil"@fr | | "2016"^^xsd:gYear |
| 8 | "SAS Parc des Ailles"@fr | | "2016"^^xsd:gYear |
| 9 | "Nant Nature et Patrimoine"@fr | | "2012"^^xsd:gYear |
| 10 | "Bois Bocage Energie"@fr | | "2006"^^xsd:gYear |
| 11 | "Plesséole"@fr | | "2019"^^xsd:gYear |
| 12 | "Centrales Villageoises du Bassin Potassique"@fr | | "2020"^^xsd:gYear |

5. SPARQL end points: Example Sophox

try it here: <https://sophox.org/>

```
#defaultView:Map
```

```
SELECT * WHERE {  
  ?pitch osmt:amenity "cafe" .
```

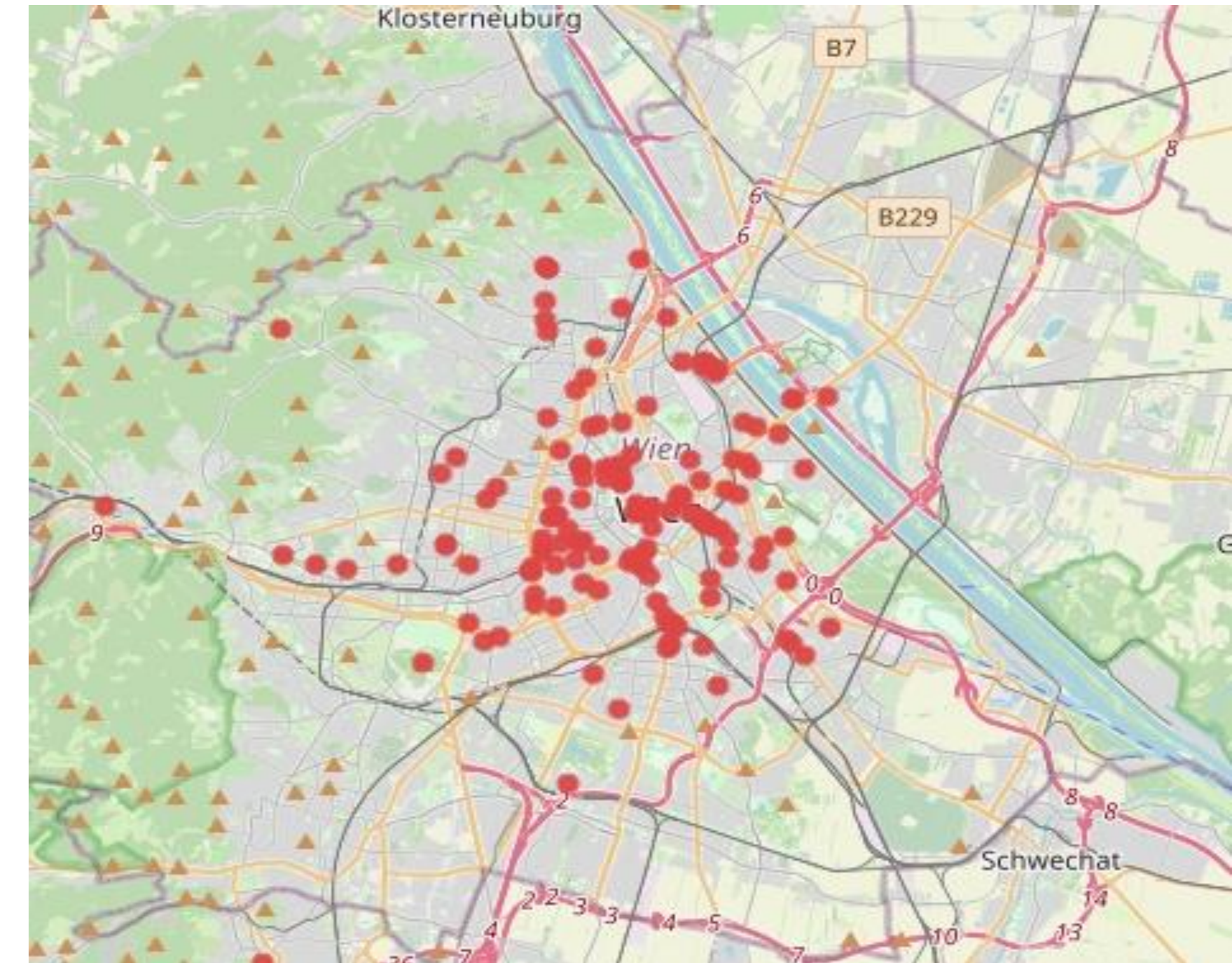
```
SERVICE wikibase:around {  
  ?pitch osmm:loc ?coordinates.
```

```
bd:serviceParam wikibase:center "Point(16.3 48.20)"^^geo:wktLiteral. # Vienna
```

```
bd:serviceParam wikibase:radius "10". # kilometers
```

```
bd:serviceParam wikibase:distance ?distance.
```

```
}  
}
```



5. SPARQL end points: Example EUROSTAT

try it here: <https://semantic.eea.europa.eu/sparql>

PREFIX qb: <http://purl.org/linked-data/cube#>

PREFIX sdmx-measure: <http://purl.org/linked-data/sdmx/2009/measure#>

PREFIX sdmx-dimension: <http://purl.org/linked-data/sdmx/2009/dimension#>

PREFIX sdmx-attribute: <http://purl.org/linked-data/sdmx/2009/attribute#>

PREFIX skos: <http://www.w3.org/2004/02/skos/core#>

PREFIX property: <http://rdfdata.eionet.europa.eu/eurostat/property#>

SELECT * WHERE { _:nrg_cb_gas qb:dataSet

<http://rdfdata.eionet.europa.eu/eurostat/data/nrg_cb_gas>. _:nrg_cb_gas

sdmx-dimension:freq ?freq . _:nrg_cb_gas sdmx-dimension:timePeriod ?date .

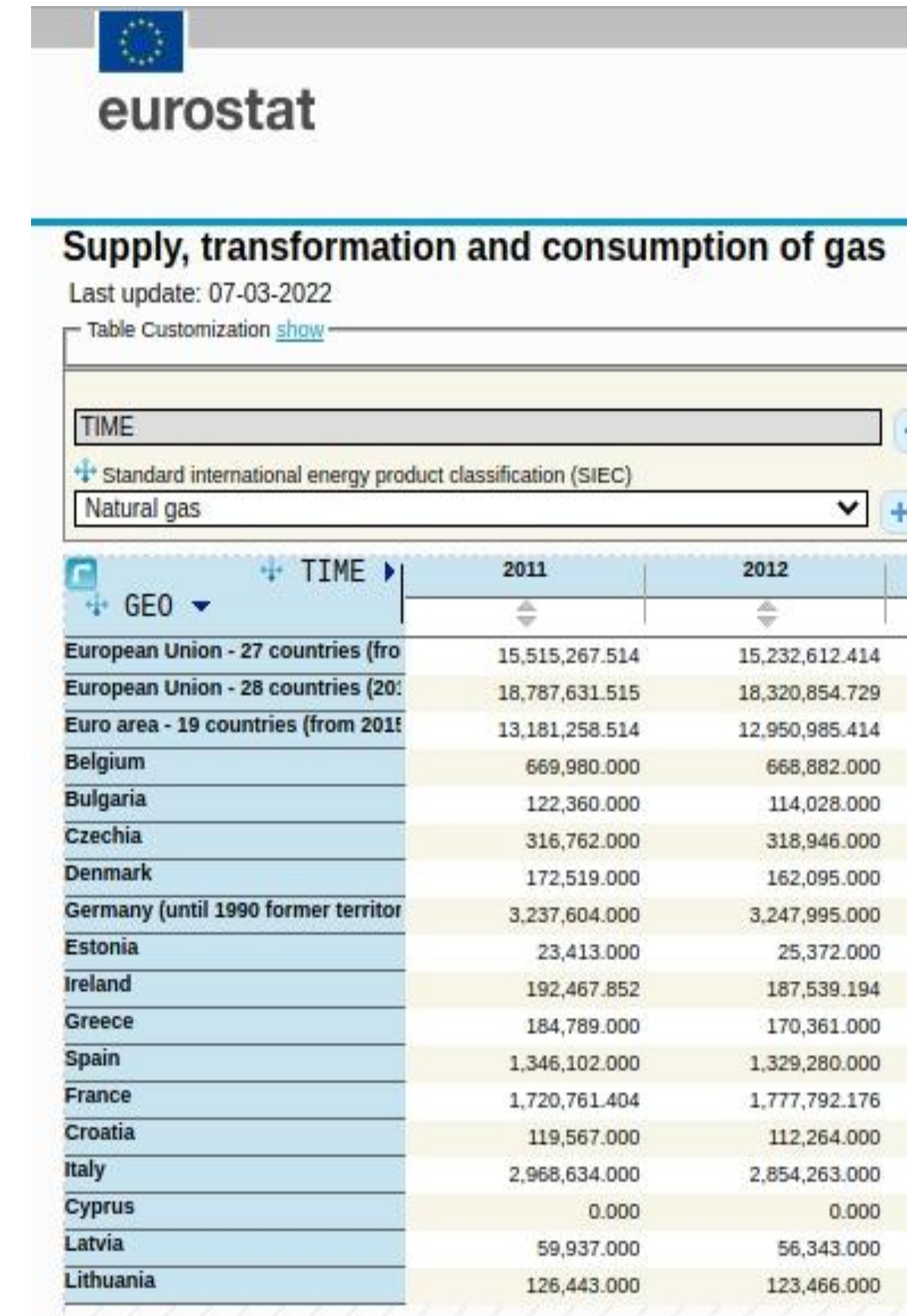
_:nrg_cb_gas property:siec ?siec . _:nrg_cb_gas property:nrg_bal ?nrg_bal .

_:nrg_cb_gas sdmx-dimension:refArea ?geo . _:nrg_cb_gas

sdmx-attribute:unitMeasure ?unit . OPTIONAL { _:nrg_cb_gas

sdmx-measure:obsValue ?obsValue } OPTIONAL { _:nrg_cb_gas

sdmx-attribute:obsStatus ?obsStatus } }




The screenshot shows the Eurostat website interface for the dataset 'Supply, transformation and consumption of gas'. The last update is 07-03-2022. The table is customized to show data for 'Natural gas' under the 'Standard international energy product classification (SIEC)'. The table displays data for 2011 and 2012 across various geographical regions and countries.

| | 2011 | 2012 |
|-------------------------------------------------------------------------|----------------|----------------|
| European Union - 27 countries (from 2007) | 15,515,267.514 | 15,232,612.414 |
| European Union - 28 countries (2007-2011) | 18,787,631.515 | 18,320,854.729 |
| Euro area - 19 countries (from 2011) | 13,181,258.514 | 12,950,985.414 |
| Belgium | 669,980.000 | 668,882.000 |
| Bulgaria | 122,360.000 | 114,028.000 |
| Czechia | 316,762.000 | 318,946.000 |
| Denmark | 172,519.000 | 162,095.000 |
| Germany (until 1990 former territory of the German Democratic Republic) | 3,237,604.000 | 3,247,995.000 |
| Estonia | 23,413.000 | 25,372.000 |
| Ireland | 192,467.852 | 187,539.194 |
| Greece | 184,789.000 | 170,361.000 |
| Spain | 1,346,102.000 | 1,329,280.000 |
| France | 1,720,761.404 | 1,777,792.176 |
| Croatia | 119,567.000 | 112,264.000 |
| Italy | 2,968,634.000 | 2,854,263.000 |
| Cyprus | 0.000 | 0.000 |
| Latvia | 59,937.000 | 56,343.000 |
| Lithuania | 126,443.000 | 123,466.000 |

5. SPARQL end points: Example EUROSTAT

| SIEC Information | | | Location Information | Value |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------|
| 1990-01-01 | http://dd.eionet.europa.eu/vocabulary/eurostat/siec/C0350 | http://dd.eionet.europa.eu/vocabulary/eurostat/nrg_bal/FC | http://dd.eionet.europa.eu/vocabulary/eurostat/geo/AT | 5596 |
| 1991-01-01 | http://dd.eionet.europa.eu/vocabulary/eurostat/siec/C0350 | http://dd.eionet.europa.eu/vocabulary/eurostat/nrg_bal/FC_IND_CPC_E | http://dd.eionet.europa.eu/vocabulary/eurostat/geo/IT | 1034 |
| 1991-01-01 | http://dd.eionet.europa.eu/vocabulary/eurostat/siec/C0350 | http://dd.eionet.europa.eu/vocabulary/eurostat/nrg_bal/FC | http://dd.eionet.europa.eu/vocabulary/eurostat/geo/AT | 5642 |
| 1992-01-01 | http://dd.eionet.europa.eu/vocabulary/eurostat/siec/C0350 | http://dd.eionet.europa.eu/vocabulary/eurostat/nrg_bal/FC | http://dd.eionet.europa.eu/vocabulary/eurostat/geo/AT | 4759 |
| 2002-01-01 | http://dd.eionet.europa.eu/vocabulary/eurostat/siec/C0350 | http://dd.eionet.europa.eu/vocabulary/eurostat/nrg_bal/DL | http://dd.eionet.europa.eu/vocabulary/eurostat/geo/AT | 1024 |
| 2003-01-01 | http://dd.eionet.europa.eu/vocabulary/eurostat/siec/C0350 | http://dd.eionet.europa.eu/vocabulary/eurostat/nrg_bal/DL | http://dd.eionet.europa.eu/vocabulary/eurostat/geo/AT | 1170 |

5. A SPARQL end point with the COMETS inventory


Apache Jena Fuseki

[dataset](#)
[manage datasets](#)
[help](#)

Server status: ●

Dataset:

[query](#)
[upload files](#)
[edit](#)
[info](#)

SPARQL query

To try out some SPARQL queries against the selected dataset, enter your query here.

EXAMPLE QUERIES

[Selection of triples](#)
[Selection of classes](#)

PREFIXES

[rdf](#)
[rdfs](#)
[owl](#)
[xsd](#)
[+](#)

SPARQL ENDPOINT

CONTENT TYPE (SELECT)

JSON




CONTENT TYPE (GRAPH)

Turtle

```

1 #
2 # filename query_predicates.rq
3 #

```

6. Showcase: Querying for predicates of an initiative

Query

```

PREFIX schema: <http://schema.org/>
PREFIX dbo: <http://dbpedia.org/ontology/>
PREFIX comets: <http://www.comets-project.eu/>

SELECT DISTINCT ?p
WHERE
{ ?cai a comets:CAI ; ?p ?o ; schema:name "Colibris"@fr . }

```



Result

```

1  <http://purl.org/dc/elements/1.1/contributor>
2  schema:foundingDate
3  schema:alternateName
4  schema:makesOffer
5  schema:streetAddress
6  schema:addressLocality
7  comets:hasEconomicActivity
8  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
9  <https://www.wikidata.org/wiki/P298>
10 <https://www.gleif.org/ontology/Base/hasNameLegal>
11 comets:hasOneMemberOneVote
12 <http://purl.org/dc/elements/1.1/date>
13 schema:postalCode
14 schema:name

```


6. Showcase: Federated query with dbpedia

```
SELECT ?cai_name ?loc ?mayor
```

```
WHERE {  
  ?c1 a schema:Organization; dbo:location ?loc ; schema:name ?cai_name .  
  SERVICE <https://dbpedia.org/sparql> { ?loc dbp:leaderName ?mayor  
  }  
}
```

Result:

"Metsäliitto Osuuskunta"@fi dbr:Espoo

"Halsuan Energiaosuuskunta"@fi dbr:Halsua

"Finnish Energy Consulting osk"@fi dbr:Helsinki

dbr:Jukka_Mäkelä

"Kalevi Lindfors"@en

dbr:City_Council_of_Helsinki

7. Conclusions

- The COMETS inventory is a set of linked databases documenting citizen-led initiatives in Europe. After the end of the project in April 2022, the inventory will be public, but no further support or maintenance will be offered.
- An implementation of the data with RDF offers the possibility to adhere to many of the FAIR guiding principles. RDF is widely used and energy-sector specific information is available. Tools to validate RDF and schema to check compliance exist.
- The SPARQL query language offers a wide range of functionality to query RDF triples and distill information from internal as well as external data resources. It comes with some basic analytic tools (sum as maximum, minimum, sum ...). Some SPARQL endpoints implement simple visualization or geographic maps.
- There are still many obstacles to guarantee a seamless access to databases: missing or hard to find SPARQL endpoints, no easy accessible standards. We are still far away from machine-actionability.